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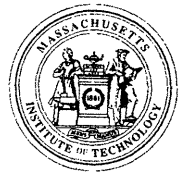

STRATEGIC TECHNOLOGY MANAGEMENT IN JAPAN: COMMERCIAL-MILITARY COMPARISONS

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Strategic Technology Management in Japan: Commercial-Military Comparisons

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Summary

The salient points of Japan's overall research and development efforts that have particular importance to the defense sector include:

- Emphasis on private sector activity — The private sector serves as the main player in R&D expenditures. Its time horizon is fixed on the long term. Management strategies emphasize examining the utility of technological applications within the context of overall corporate goals.

- Limited government role — The government role as an initiator is most prominent when risks are highest and the potential payoffs are not evident in the foreseeable future. As soon as a budding technology appears to offer more substantial gains at lower risk, the R&D effort is turned over to the private sector. Government strategies assess technological inputs in terms of their net effect on the national economy.

- Strong institutional and informal integration of government and business R&D activities — Government and business interact at several formal and informal levels and in doing so develop a clear consensus on R&D directions. While the private and public sectors do not necessarily see eye to eye on all major issues, there nevertheless is a degree of cooperation and coordination that is not always evident in other countries. Furthermore, government ministries encourage integration of perspectives and a comprehensive outlook on technological efforts through such mechanisms as seconding government employees in various agencies and ministries.

- Emphasis on dual use, multiple application technologies — Advanced technologies with a single or limited application are not as attractive as those offering multiple applications. The R&D management process tends to weed out technologies with limited applications or defer their development. While spinoffs are sought, an equally if not more important consideration is "spin-on:" the utilization of technologies to produce new products or even industries. The close integration of business and government activities along with an emphasis on focusing R&D efforts on the private sector help assure the development and utilization of dual use technologies. It is not a case of developing, say, a process or product in a government military laboratory and then attempting to find applications in commercial fields. To a large extent, military and commercial interests are merged by the institutional structures and management attitudes evident in business and government.

• An emphasis on research collaboration — In both military and civilian fields, technological research and development programs with particularly far reaching implications tend to be organized around private sector consortia in a manner that encourages cross fertilization at preliminary stages while assuring benefits from free competition in later development stages. Collaboration is not the sole means of bringing technology into commercial or military marketplaces, but it does play a unique and important role.

Introduction

Although defense research and development expenditures still account for only a small part of Japan's annual budgets, the government is placing significant emphasis on the development of indigenous weapons systems and the utilization of domestic technologies for defense applications. The defense policymaking establishment recognizes that Japan's capability to defend itself against potential threats, particularly in the face of a weakening U.S. presence in Asia and a decline of American economic power, rests on its ability to field superior technology in the form of advanced weapons systems. The 1988 issue of *Defense of Japan*, the annual statement of defense policies issued with cabinet approval, declares that

> ...it is particularly important to continue efforts to maintain and improve the technological standards related to military equipment required for national defense in years to come. Japan is the second largest economic power in the Free World and has a high level of industrial technology capable of independently carrying out research and development projects in the field of high technology. The Defense Agency is conducting research and development by taking advantage of technological expertise accumulated in the private sector...It has been increasingly necessary for the country to direct more positive efforts to research and development on equipment."[1]

Japanese defense technology strategies are intertwined with a broader process of technology management in government and industry that emphasizes the nurturing of dual use technologies to assure Japan's security in the broadest sense during the coming century. It is essential to look beyond narrow definitions of security to appreciate the thrust and implications of Japanese defense technology management. Security does not extend solely to protection from a perceived military foe. Rather, it includes a multitude of economic and political factors that tend to unify interests in business and government in Japan. One must therefore examine the roles and perceptions of these groups to grasp the Japanese formulation and implementation of technology management policies as part of a larger economic strategy. As evidenced by the priority on developing dual use technologies with multiple applications, Japan's technology policies are generated and implemented in a manner that merge economic, security and industrial policy considerations. As a result, the line between purely defense

[1] *Defense of Japan, 1988* (Tokyo: Japan Times, 1988), p. 135, 136.

and civilian technologies is consciously blurred to assure maximum utilization of emerging applications and processes.

This paper examines the mechanisms and practices that result in this policy mix by reviewing 1) the most important player in Japanese research — the private sector; 2) the nature of industry-government interaction in research and development; 3) the players and processes in defense decisionmaking; and 4) the research patterns evident in commercial research that are manifested in defense related efforts as well as the specialized role of defense research offices.

R&D in the Private Sector

Japanese management of defense related technology must be addressed in the context of overall research and development in Japan, and particularly in terms of the role of industry and government-industry collaboration in achieving targeted goals. Only recently have economic, political and institutional constraints on defense spending moderated sufficiently to identify a more specific defense component in those efforts. Research and development funding is dominated by the private sector in Japan. Because of that dominance, business practices in commercial development figure prominently in defense related R&D.

The United States still spends more in aggregate on research and development than Japan. Nevertheless, Japan now spends a higher portion of its GNP than the U.S. on research — 2.8 percent for Japan compared to 2.7 percent for the United States in 1985. The Japanese government estimates that this will increase to 3.4 percent of Japan's GNP by 1990 and 5.3 percent by 2000, compared with 2.9 percent and 3.4 percent for the United States over the same period.[2]

Approximately 50 percent of all U.S. R&D spending is related directly to the military (estimates go as high as 70 percent). The percentage for Japan is far smaller (although increasing) with 80 to 90 percent of all funds — government and private sector combined — directed toward commercial applications. Private sector R&D dominates the Japanese technology process. Whereas half of all U.S. research is funded by the government, approximately 75 to 80 percent of Japan's total R&D allocations reside in the private sector.[3]

All of these factors have been cited as reasons for Japan's efficiency in applying new or improved technologies in products. But it is not a matter of funding alone. Business and government give priority to projects that will

[2]Jon K.T. Choy, "Technological Innovation in Japan and the United States," *The World and I*, November 1988, p. 171-172. The budget for the Technical Research and Development Institute (TRDI) — the research and development arm of the Japan Defense Agency — accounts for just under 5 percent of total government R&D expenditures. Research in private firms accounts for the remainder of total defense related R&D.

[3]Choy, p. 172.

provide a net technological gain to the domestic economy and/or serve as source of innovation for other industries and sectors. If there is a consensus that the potential payoffs are likely to be very significant, investors and researchers will allow even greater time spans to allow fruition of the technology. Innovation is viewed not simply as a means of achieving economic breakthroughs but also as an ongoing process that must be incorporated into every phase of development and production. Japanese firms will invest in a series of incremental improvements in products despite the costs while U.S. firms often look for more sweeping and perhaps elusive breakthroughs.

One basic difference between the U.S. and Japanese systems of innovation is involvement of engineers, researchers and other technical specialists in both determining priorities among potential research projects as well as their participation in the design and development phases of new products. Production and manufacturing considerations are merged with development and design stages virtually from the initial consideration of a promising technology all the way through the production phase. These considerations are incorporated into product design and thus necessitate fewer costly and time consuming modifications at later stages. It is still difficult to determine if the same can be said without qualification in defense production but it would not be surprising if similar attitudes and practices prevailed.

Another fundamental point is that in many cases Japanese firms are not necessarily leaders in underlying technologies but do excel in process technology — the mundane but essential capability to produce goods more efficiently than other competitors. Again, this is attributable in part to close cooperation and collaboration among designers and production personnel at the earliest phase of a product's development.

A final characteristic is the commitment of top management to promoting technological advances within their companies. The participation of higher level managers and corporate officials varies from one firm to the next, but there is corporate wide awareness of and support for ongoing research. Funding decisions frequently are made at senior levels. Research results are circulated systematically throughout corporations, even within sales and marketing divisions.[4]

R&D in the Public Sector

In terms of government funding, the Science and Technology Agency (STA), Ministry of International Trade and Industry (MITI) and Ministry of Education (MOE) constitute the three largest players in Japan's government directed research and development. (For the purposes of this paper, I will focus on the first two. Much of the size of the Education Ministry's budget is

[4]Shogo Sakakura of the Japan Society of Science Policy and Research Management details these and other characteristics of Japanese research management in "A Fact Finding Survey of Research Management in Private Research Institutes," MIT-Japan Science and Technology Program Paper No. 88-12.

attributable to the fact that it is responsible for managing educational research facilities.) Total government funding will reach ¥1.71 trillion ($13.7 billion at current exchange rates) during the current fiscal year, with STA and MITI accounting for ¥431 billion and ¥221 billion respectively (see details below).

Table 1: Science and Technology Budget Allocations, FY 1988

(millions of yen)

Ministry/Agency	Total Allocations	% Change From Previous Year
Education	812,954	4.2
Science and Technology Agency	430,955	1.3
International Trade and Industry	221,226	-0.1
Japan Defense Agency	82,700	11.6
Agriculture, Forestry, Fisheries	66,642	-0.2
Health and Welfare	44,059	10.8
Posts and Telecommunications	30,279	4.3
Transportation	14,627	0.8
Environmental Protection Agency	7,752	-2.0
Foreign Affairs	6,417	1.9
Others	14,894	0.6
Total	**1,706,504**	**3.1**

Source: Ministry of International Trade and Industry, Agency of Industrial Science and Technology

A broad consensus on the value of research and development efforts exists in Japan that provides a stable political and economic environment for the pursuit of long term goals. Bureaucratic organization and industry lobbying help assure the preservation of that consensus. STA, for example, is organized under the office of the prime minister while MITI's research programs report directly to the head of the ministry. At the broadest level, scientific research trends are monitored and influenced by advisory councils associated with the office of the prime minister. These councils fulfill multiple roles, including facilitating the creation of a cabinet wide consensus on appropriate government policies and allocation of resources. They also legitimize initiatives developed in the private or public sector through public endorsements. Council reports can provide stimulus in specific fields. Space exploration, for example, has become a national priority in part because of the role played by these advisory councils in articulating government visions and stirring the national imagination.

Government laboratories and research institutes fulfill a variety of roles in the Japanese R&D process. They do not simply create new technologies or initiate larger research projects. While often serving this purpose, government facilities are equally important for their role as neutral testing

grounds to verify results achieved in private sector labs and to carry research to a point where it becomes more economical to pursue it in private sector facilities. Given these roles, which are clearly perceived in both industry and government, it is understandable that considerable business-government interaction takes place at all levels of the research process: from individual researchers to their supervisors and the directors of respective facilities.

Despite the efficacy of Japanese R&D efforts, the process is not faultless. Inter-ministry integration and cooperation is not always as thorough as it could be. There have been instances in which ministries have competed against one another for prominent roles in research initiatives, forcing political compromises that also wastefully duplicated efforts. (Competition over budgets for space activities comes to mind). Important initiatives can fail as well, even when there is a clear consensus of views in government and industry. An aerospace effort in the 1950s, for example, produced the YS-11, a small passenger aircraft intended for commercial use that fell far short of its ambitions.

By the same token, there is not necessarily a nationwide or government wide consensus on the value of defense production and research for the overall economy. While it is argued in this paper that the country has embarked on a policy emphasizing domestic research and development of advanced weapons systems, that policy is not universally embraced nor is it without frictions. The Ministry of Finance retains the philosophy that virtually any spending on defense comes at the expense of the economy (thus necessitating active lobbying by industry to convince the ministry of the domestic economic value of, say, an indigenous fighter-support aircraft). A number of major research efforts within civilian ministries and agencies have clear potential for military applications. Among them are artificial intelligence research, high performance plastics, fine ceramics, advanced alloys, jet engine research and deep sea mining systems, to mention only a few. Although both the public and private sectors are examining possible military applications, the projects nevertheless are justified primarily because of their expected positive impact on the civilian economy.

Research Collaboration

Selective collaborative research, particularly in the precompetitive phase, plays an important role in realizing technological gains in the public and private sectors. Collaborative undertakings are widespread but they are not necessarily the rule in Japanese research efforts. The nature, timing and participants of collaborative efforts vary from one field to the next. Nevertheless, they are prominent features in Japanese efforts to bring technology to the marketplace. Informal and formal processes identify promising research fields or significant trends. Once a government and industry consensus has been reached on more specific avenues of research, what frequently follows is the establishment of a government-industry collaborative effort or a government sanctioned research consortium involving the participation of multiple private sector interests. As research

proceeds, greater competition is introduced to hasten the introduction of a product to the marketplace.[5]

Interviews with corporate figures suggest that many companies are less committed to the consortium approach than they might have been in earlier decades, arguing that important resources are being diverted from corporations to government sanctioned consortia without demonstrating sufficient potential for tangible gains. Some firms have suggested that their own resources and decisionmaking processes are sufficient for stimulating technological advances and while not resenting the government role, believe that it should be reduced or shifted to other forms of involvement in R&D. These same companies, however, remain participants in deference to government relations considerations and out of the competitive concern that a development or breakthrough will indeed arise from a consortium to which they would not be a party if they did not participate.

This situation is not likely to change in the near future. In the area of defense technology, for example, there are a large number of industry consortia, including those in composite materials, advanced turboprop research and fighter aircraft. Japanese managers feel that the market is too competitive to risk a totally independent course of action. Cost is another factor favoring cooperation as well, especially in large scale projects originating in, but not necessarily limited to the defense field. Finally, projects such as the FSX are seen literally as once in a lifetime opportunities that if neglected could lead to the complete loss of important capabilities.

Defense Decisionmaking

It is in this environment that Japan establishes policies governing the management of its defense technology base. Defense issues have assumed greater prominence in recent years. Nevertheless, Japanese defense policymaking remains constrained and is subject to negotiation among often competing interests. Historical and institutional factors help explain this. For example, broad defense policies — and thus decisions regarding allocation of national resources to major defense R&D programs — are not the sole domain of the Japan Defense Agency (JDA). JDA is not as autonomous or influential within the Japanese government bureaucracy as the Department of Defense is in the United States. Budget constraints have remained severe throughout the postwar era. Until recently, popular and political support within Japan for defense has been muted or limited, curtailing the agency's relative influence in the government. The agency has been unable until recent times to attract Japan's most promising college graduates, who preferred joining more prestigious government ministries including the Ministry of Finance (MOF) and MITI.

Institutional factors also influence JDA's role as one among many in determining defense policies. Multiple players with differing agendas and perspectives interact to generate policies that can be accepted by the

[5]For an analysis of collaborative research in Japan, see Richard J. Samuels, "Research Collaboration in Japan," MIT-Japan Science and Technology Program Paper No. 87-02.

government as a whole. The most direct form of influence over defense policies is the Ministry of Finance's budgetary power. In the more centralized budget process of the Japanese government, MOF has wielded considerable influence aimed primarily at restricting the growth of defense budgets under the assumption that such spending constituted a drag on the economy. In recent years, however, defense proponents have been successful in securing spending increases far higher than those for other agencies.

Despite this newly found influence, however, major defense policy decisions are only recommended by JDA, subject to the approval of the Security Council of Japan, a formal body chaired by the prime minister that includes the ministers of finance, international trade and industry and foreign affairs, along with such officials as the director general of the Economic Planning Agency (EPA). The Security Council replaced the weaker National Defense Council in July 1986 and is the final arbiter of such policies as the agency's long term procurement plans. The Security Council's influence means that much of Japan's defense policymaking process is intertwined with non-defense interests. Diverse and wide ranging interests influence the defense policymaking process through organs such as the Security Council. These interests include domestic industrial concerns (as represented by MITI), fiscal and monetary interests (represented by MOF) and macroeconomic policy outlooks (in the form of EPA interests). MITI's aircraft and ordnance division is particularly influential in Japanese procurement decisions.

Influence by other ministries is exhibited within JDA itself. Many of the key positions in the agency are occupied by officials seconded from other ministries. The director general of the procurement bureau usually is headed by a representative from MITI with experience in the ministry's aircraft and ordnance division. The finance bureau is staffed by a Ministry of Finance employee. Many policy planning positions are filled by personnel on leave from the Ministry of Foreign Affairs (MOFA). MOFA also can have considerable influence on overall Japanese security policies by virtue of its role in the formation and implementation of the country's foreign policies. That influence varies from one government to the next, but it has institutional mechanisms such as U.S.-Japan bilateral consultative and working groups established under the auspices of the mutual security treaty to preserve its role.

Incorporating other ministry and agency interests in the defense policymaking process need not be a divisive dynamic. Indeed, while different agencies' interests often compete with one another in this situation, this process nevertheless contributes to the formation of policies with widespread government support. Inter-agency negotiation of defense policies tends to integrate economic, security and industrial policy perspectives in addressing defense policies. While the presence of seconded officials within its halls might have drawbacks from JDA's perspective, it also means that a growing cadre of government officials have been integrated in the defense policymaking process — including the domestic economic, industrial and developmental aspects of defense

policies — by virtue of their service within JDA.[6]

The Technical Research and Development Institute

It is within this context that the Technical Research and Development Institute (TRDI) operates. Organized as a division within JDA, TRDI is the agency's primary research organization and is headed by a civilian who overseas three administrative departments along with four uniformed directors who supervise research and development in ground, naval and air systems, as well as precision guided munitions. Conceptualization, design and prototype responsibilities are fulfilled at this level. Research centers carry out survey research, testing and evaluations to enable further development on specific systems. Authorized manpower is 1,179, which includes 256 uniformed personnel rotated from the three branches of the Self-Defense Forces. TRDI maintains five research facilities in Japan which test and evaluate a broad range of weapons systems and technologies (see Appendix for a complete list of the facilities and their areas of research). The Institute has no prototype manufacturing capabilities, relying on privates sector capacities instead.[7]

The R&D component of the Japanese defense budget has grown at over 10 percent annually for the last five fiscal years. TRDI's total budget in FY 1988 (April 1, 1988 - March 31, 1989) comes to ¥81.8 billion, ($682 million at current exchange rates), approximately 2.21 percent of Japan's total defense budget. On January 19, 1989, the cabinet approved a 6.1 percent increase for FY 1989 to bring that total to ¥86.7 billion.[8]

As a matter of policy, JDA is seeking to continue its upward R&D spending trend and boost total R&D expenditures to 2.5 percent of the defense budget by the end of FY 1991. Much of this reflects decisions to proceed with "big ticket" items for utilization by the different services. Major projects include the SSM-1 surface-to-surface missile (from which anti-ship and other derivatives are anticipated); a new main battle tank for the Ground Self-Defense Forces to succeed older, domestically developed models; the XSH-60J anti-submarine helicopter, a codevelopment project with the United States designed to replace outdated aircraft; and, last but certainly not least, the FSX next generation fighter-support aircraft, another codevelopment effort led by Mitsubishi Heavy Industries from Japan and General Dynamics from the United States. JDA and TRDI also have proposed four specific technology areas for codevelopment projects with the United States. In October 1988, the two countries initialed an agreement to

[6]The number of annual entrants to the government as a whole and individual ministries remains fairly stable from one year to the next, so presumably JDA success in attracting more qualified applicants could come at the expense of other ministries and strengthen its internal bureaucratic position.

[7]*Defense of Japan 1988*, p. 137.

[8]*Defense of Japan 1988*, p. 137, 312; *Kokubo* (*National Defense*), Vol. 37, No. 10, October 1988, p. 102; Nikkei News Bulletin, January 19, 1989, "Defense Budget Up 5.2% but Below 1% of GNP." JDA had sought an increase of 12.9 percent for TRDI's FY 1989 budget, more than twice what was approved.

codevelop new missile guidance technology.[9]

TRDI's early postwar effort was directed largely toward reinventing the military technology wheel. With limited resources, bureaucratic constraints, a lack of popular support and other factors hindering R&D efforts, the organization was not capable of launching high risk projects of its own accord. That situation has begun to change. With greater public acceptance of defense policies, TRDI has been able to recruit promising technical graduates from leading educational institutions.

Table 2: Technical Research and Development Institute Spending, FY 1968-88

(percent of total defense spending)

Fiscal Year	Percent
1968	2.01
1976	1.21
1984	1.49
1985	1.84
1986	1.95
1987	2.08
1988	2.21
1989 (preliminary)	2.21
1991 (goal)	2.50

Source: Defense of Japan, 1988

TRDI was established to develop independent weapons development capabilities and enhance the growth of the domestic arms industry. Limited direct participation in defense related R&D has been a guiding principal from the outset, in part to minimize government budget outlays but also because of the assumption — still active today at least within the Ministry of Finance — that defense spending constituted a burden on the civilian sector and therefore should be limited (private industry and other government ministries do not necessarily share this view, but MOF controls the purse strings).[10] Thus, to a large degree TRDI has managed its defense technology to date according to its impact on the domestic economic/technological base. The Institute does not necessarily target the development of technologies to field specific weapons systems (although JDA has been accused of deferring procurement of foreign systems until domestic counterparts could be developed.)[11] A consistent criterion for

[9]*Defense of Japan 1988*, p. 138-145; Kyodo Economic Newswire, October 6, 1988. The phrase "codeveloped" often is used in Japan in reference to modification programs involving for example, changes to a U.S. airframe or other structure to accommodate introduction of Japanese electronics. The missile homing project, however, does appear to involve more fundamental efforts.

[10]For a discussion of the origins and early projects of TRDI, see Boei Kenkyukai, *Boeicho; Jieitai* (Tokyo: 1988), pp. 269 ff. (Defense Research Committee, *Japan Defense Agency; Self-Defense Forces*).

[11]Despite the high priority given by the Ground Self-Defense Forces to fielding advanced

the selection and nurturing of technologies has been the impact of any given technology on the commercial sector. The chances that a given technology will be targeted for development are higher if it contributes to the overall industrial base and will provide opportunities for other spinoffs/spin-ons. For example, emphasis placed on radar development reflects industry and government interests as wide ranging as phased array systems for fighter aircraft, 360° radar for commercial air traffic control, and collision avoidance systems for automobiles. Composite materials is another field offering similarly diverse applications.

Thus, an important element of the Japanese strategy is much like one used in drafting professional football players. Rather than find the best player for a specific position, TRDI often "drafts" the best technology available at the time regardless of the position it plays. What is important is that it is an "impact player" capable of producing benefits to the "team" over the long run. The U.S. security guarantee, of course, has contributed to a situation in which Japan has more flexibility in making these decisions. As long as the U.S. defense umbrella remained credible, Japan could afford gaps in its domestic defense technology as well as its deployed forces until it had sufficient time to develop indigenous capabilities. It is important to keep this point in mind when comparing U.S. and Japanese strategic technology management, although it does not necessarily lessen the potential importance of lessons for the United States to be drawn from Japanese experience.

The combination of a government posture that historically has been concerned about drains on the civilian economy and the emphasis on broad applications of new technologies has led to close government-business interaction in defense areas, reflecting practices in commercial sectors. TRDI works with industry in both formal and informal manners. In many cases, the organization simply monitors research already under way in private companies. In others, it carries out preliminary research that ultimately is handed over to the private sector once it has reached a stage where risks have been reduced and the potential for the technology has proven itself. The development of the F-1 fighter support aircraft, SSM-1 cruise missile and T-2 trainer all illustrate that pattern. In some cases, companies will pursue their own R&D projects with implicit understanding that ultimately it will be funded by JDA (industry observers suggest that the short range Tan-SAM missile is one such example). In most cases, firms avoid labeling such research as defense R&D due to political

tanks, for example, deployment was delayed until a purely domestic model was developed to TRDI's satisfaction. Journalistic accounts of the Japanese procurement system also accused the government of delaying consideration of short range surface-to-air missile systems for air base defenses until the Tan-SAM was fully developed. More recently, industry backers of a domestic fighter-support aircraft to replace aging F-1s called in 1987 for further feasibility studies and/or the development of a domestic prototype aircraft with the tacit support of the Air Self-Defense Forces when it appeared that then JDA director general Yuko Kurihara would decide in favor of a codevelopment project with the United States or the acquisition of an American aircraft. Such delays presumably provide opportunities to enhance domestic industrial capabilities and spinoff/spin-on opportunities as well. See Richard J. Samuels and Benjamin C. Whipple, "Defense Production and Industrial Development: The Case of Japanese Aircraft," MIT-Japan Science and Technology Program Paper No. 88-09.

considerations.[12]

Heavy reliance on the private sector was reinforced by a reorganization in July 1987 that eliminated minor research programs that could be pursued more effectively by private sector research facilities. In addition, TRDI's role was defined to include research that lacks an immediately identifiable demand in commercial sectors. This could be an important development for TRDI's institutional role, perhaps representing a judgment by JDA that fielding advanced weapons systems will require selective development of specialized technologies with solely military applications.

At the same time, however, a flexible approach was emphasized to maximize the utilization of commercial technology in military systems — all with the ultimate aim of making Japan equal or superior to other countries in terms of its defense technology base.[13] This outlook is summarized in the current white paper:

> The Defense Agency will positively utilize the private sector's technology on the basis of its excellent technology in the field of microelectronics and new materials including ceramics and composite materials. Particularly in the area of basic research the Defense Agency will rely heavily on the technology pooled in the private sector. Furthermore, the Defense Agency, carrying out a technological research project to integrate private technology into future high-technology equipment, will build it up as a system that will meet the unique operational requirements of this country. Accordingly, the Defense Agency will achieve effective improvement of superior equipment capable of competing with technological standards of foreign countries.[14]

Institutional and informal mechanisms comparable to those outlined earlier tend to reinforce utilization of commercial capabilities for defense in both research and manufacturing. Close links plus the overriding philosophy emphasizing commercial benefits/inputs help assure that military related research benefits the commercial sector (spinoffs) and that commercial, off the shelf technologies are utilized to the fullest extent possible in military systems (spin-ons). Furthermore, even in the case of "purely military" technologies, TRDI can be expected to follow the pattern of relying on

[12] Japan's official definition of military weapons and, by implication, the underlying technology is indicated in the Export Trade Control Order. The official list of military weapons includes only eleven product categories. For example, "firearms and cartridges... ammunition...[and] explosives" are included in the list along with "military vessels and the hulls thereof, as well as parts thereof [and] military aircraft, as well as parts and accessories thereof." The key distinction between "weapons" and non-military exports is in their ultimate utilization. The product must be "used by military forces and directly employed in combat" to qualify as weapons. These definitions often are characterized either as excessively vague or, as one expert notes, literally restricted to "things that go 'bang.'" In addition, definitions of military related products and technology have become increasingly difficult with the proliferation of dual use technologies with significant commercial and military applications.

[13] *Defense of Japan, 1987*, p. 140.

[14] *Defense of Japan, 1988*, p. 136.

private sector development as soon as feasible. Business and government will also seek to optimize applications in defense and commercial sectors.

Private Sector Interaction

The private sector plays an important role in developing a consensus on overall R&D trends as well as specific projects through individual company contacts and various industry associations. The most influential of these groups most likely is the Defense Production Committee of Keidanren - the Federation of Economic Organizations.[15] The DPC consists of about 10 percent of Keidanren's total membership of 800 industrial companies and over 100 financial institutions. It officially serves four functions:

- Compile basic data on defense production.
- Collect and circulate information relating to defense production developments and trends.
- Promote cooperation among defense contractors.
- Coordinate defense and non-defense industries and interests.

A fifth, but unofficial purpose is to promote the interests of its members among government agencies and policymakers. Given these objectives, it is not surprising that the DPC plays a significant role at least as a forum for discussion and dissent among contractors on defense issues. The committee will refuse to take stands where industry wide concurrence is impossible or momentarily beyond reach, but it will promote positions on which there is a clear cut consensus of views. The group issues an annual report on defense related issues. It consistently has favored higher domestic production rates and indigenous weapons development. Most recently, the group has called upon the government to allocate greater budgetary resources to defense related R&D, supporting JDA's target level of 2.5 percent of the total defense budget.[16]

Since its establishment in 1952, virtually every chairman of the DPC has come from Mitsubishi Heavy Industries. While it is beyond the scope of this paper to examine the implications of that dominance, it is nevertheless worth noting that such consistency has given MHI a means of assuring its preeminent status as Japan's number one defense contractor and of projecting its views of defense issues on the domestic industry as a whole.

Other groups playing comparable roles include the Japan Ordnance Association, the Society of Japanese Aerospace Companies (SJAC) and the Japan Shipbuilding Industry Association. In addition, the Japan Technology

[15]A dated, but still largely accurate portrayal of the Defense Production Committee in action is David Hopper, "Defense Policy and the Business Community: The Keidanren Defense Production Committee," in James Buck, ed., *The Modern Military Japanese Military System* (Beverly Hills: 1975), pp. 113-148.

[16]For other Keidanren DPC perspectives, see Editorial Committee, Asagumo Shimbunsha, *Sobi Nenkan, 1988* (Tokyo: 1988), p. 479. The Japan Ordnance Association expresses its policy positions on pp. 480-482.

Association was created in 1980 with the support of such diverse commercial firms as Sony and Honda Motors. These associations, along with other industry interests such as trading companies, can have a significant role in the formative stages of major policy developments. This is due in part to the lack of outside, independent consultants available to U.S. government agencies to address pending policy and procurement issues.

Senior executives of leading defense contractors who are also officials of these associations routinely serve on key advisory panels —*shingikai* — for MITI, the defense agency and other government agencies. These panels, like the Defense Science Board in the United States, are an important conduit of information and influence between business and government. Moreover, it is not uncommon for major companies to provide JDA with technical analyses of competing weapons systems for use in determining a final selection for procurement. It is not unusual for governments in other countries to turn to private interests for such analyses but Japan lacks the Booz-Allens or Rand Corporations that normally would provide them in the United States. Since these same firms also act ultimately as the developers, manufacturers or procuring agents for these systems, their involvement in such fundamental activities gives them significant opportunities to shape the course of future policies in a manner that serves private sector interests. In research and development projects, it also allows them insights into government perspectives that might otherwise be limited or unavailable altogether.

Industry influence and interaction are further strengthened by the increasingly common practice among major defense contractors, industry associations and trading companies of hiring retired, senior JDA and SDF personnel as advisers in defense matters. This does not differ markedly from the United States except to the extent that such relationships are the result of longer term interaction than might be evident in the U.S. experience. Furthermore, potential access to higher levels of government across the board is great if the new adviser retired from a senior position after serving in several ministries throughout his career.

Companies frequently attempt to anticipate and prepare for major policy developments through the formation of informal study groups on specific issues or trends. For example, the aerospace department of a major trading company might form such a group to collect data and examine satellite utilization and technology to identify potential business opportunities. Participants would include representatives of comparable departments or divisions from other companies and by informal agreement, the group would work under the supervision of a lower mid-level executive of the organizing company. Government officials might informally participate as well. Ultimately, the head of the trading company's aerospace department would become involved if significant opportunities were identified by lower ranking staff members. At that point, the focus would shift to one or more of the industry associations and the study group would disband.

Such early interfirm cooperation has the effect of consolidating industry perceptions toward emerging business opportunities and can also help identify specific roles for individual companies once projects move into the research, development and production phases. Firms are motivated to continue participating in these arrangements because of their desire to secure some portion of the business resulting from a major procurement decision. The Japanese defense market is an oligopoly and government procurement decisions reinforce a pattern in which only a few firms can develop specific manufacturing and production capabilities. Given that situation, no one firm will secure the lion's share of a major procurement order. Their participation in the formal and informal mechanisms outlined above, however, can help assure that they receive at least a part of the business.

A point to emphasize again here is that firms at this stage are not necessarily approaching these areas in terms of their potential for military business per se. Instead, a broad focus is maintained in which business opportunities are identified and analyzed in terms of their overall relationship to a company's strategic plans and objectives. In the United States it is often noted that the Defense Department does not field technology, but weapons. Implied in this is the notion that weapons are unique commodities often requiring technology or performance capabilities that distinguish them entirely from commercial items. By extension, it also suggests that unique breakthroughs and/or processes are essential to the development of new systems. In the Japanese case, where private sector and commercial ministry interests play a very important role, it is safe to say that JDA fields neither technology nor weapons, but products. Companies treat weapons research, production and sales as another element in broader marketing strategies. This approach emphasizes multiple applications for existing and emerging technologies and products.

This is due in part to the fact that unlike the situation in the United States, there are few clear-cut defense contractors in Japan. Mitsubishi Heavy Industries, for example, secures on average about 25 percent of JDA's total annual procurement budgets, translating to 15 percent of its total sales. Distribution of JDA contracts diversifies dramatically once MHI's share is accounted for. Of major contractors, only one — Japan Aviation Company — depends virtually entirely on defense contracts for its survival.

Firms are diversifying, however, to emphasize defense related sales. MHI's 15 percent of sales in the defense field, for example, has grown from just over 7 percent a decade ago. Nissan Motors now officially describes itself as a defense contractor in its corporate charter. Fujitsu, Ltd. has established a corporate goal of increasing defense sales 20 percent annually.[17] As mentioned earlier, firms as diverse as Sony and Honda are keenly interested in defense sales and applications for existing and new technologies. But rather than looking at defense as a new field requiring

[17]Nikkei News Bulletin, December 30, 1988, "Fujitsu to Boost Defense-Related Business." For additional information about the Japanese defense industry, see Michael W. Chinworth, "Japan's Defense Industry," *JEI Reports*, No. 1A, January 9, 1987 (Part I) and No. 7A, February 20, 1987 (Part II).

different marketing strategies, companies are incorporating their defense strategies as new components of broader commercial plans, again with an emphasis on achieving maximum gains from any given technology or product.

Self-Image, External Evaluations and Implications

Japanese policymakers and observers alike increasingly view the country's technological capabilities as second only to those of the United States — and even then just barely in terms of many specific technologies. The 1987 STA white paper concluded that within the past two decades, Japan's inherent technological strength and its potential for future technological development relative to the United States surpassed West Germany, France and the United Kingdom.[18] A recent assessment of Japan's future role in the world — *Nihon no Sentaku* (*Japan's Choices*) — completed by a MITI sanctioned commission, has determined that Japan in fact *leads* the United States in many critical fields and is closing ground on virtually every other technology that will prove of importance in the coming century. This includes space communications, launch vehicles, robotics, large scale integrated circuits, civil aerospace, biotechnology and artificial intelligence, to name only a few.[19] The Defense Science Board of the United States concurred that Japanese capabilities in dual use technologies offered great potential for use in advanced U.S. systems in its 1984 report on industry to industry arms cooperation. A subsequent DOD task force identified a more specific range of technologies.[20]

These assessments represent an increasing appreciation of Japan's capabilities abroad but they are even more significant in terms of the country's domestic outlook because they show a heretofore restrained confidence in its capabilities to lead the world in technologies that have both commercial and military importance. This development of itself, of course, should not necessarily cause concern to the United States and other allies of Japan. There are signs of payoffs in the form of U.S.-Japan cooperation. The two countries concluded notes in November 1983 to allow military technology exchanges and in 1987 Japan agreed to participate in the Strategic Defense Initiative (the first SDI contract involving a Japanese firm was signed recently). Furthermore, the two countries have embarked on a less heralded project — the development of a new missile homing system — that could be an even more promising indication of things to come.

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[18]Science and Technology Agency, *Kagaku Gijutsu Hakusho 1987* (Science and Technology White Paper 1987), pp. 40-42.

[19]Ministry of International Trade and Industry, *Nihon no Sentaku* (Tokyo: 1988), pp. 184-193.

[20]U.S. Department of Defense, Office of the Under Secretary for Research and Engineering, *Report of the Defense Science Board Task Force on Industry-to-Industry Armaments Cooperation, Phase II: Japan* (Washington, D.C.: 1984), pp. 15-17. U.S. Department of Defense, Office of the Under Secretary of Defense (Acquisition), Research and Advanced Technology, *Electro-Optics and Millimeter-Wave Technology in Japan* (Washington, D.C.: 1987), pp. 3-1 ~ 4-4.

Nevertheless, it is important to view the Japanese R&D effort in perspective. Japan equates technological advancement with its chances for survival in the future. The 1987 STA white paper concluded that virtually 50 percent of all Japanese economic growth in the fifteen years since the oil shocks was attributable to advances in the domestic technological base, compared with 20 percent at most for the United States.[21] (It is safe to say that in terms of defense outlays, much of the growth on the Japanese side would be attributed to the dual-use, multiple application strategy in which a focus on solely military technologies has been discouraged. For the United States, no doubt an opposite conclusion would be reached; namely, that excessive attention to strictly military R&D has served as a drag on the overall economy.) These gains have resulted in productivity improvements and the creation of new demand for products that simply did not exist a decade ago. Small wonder the government places heavy emphasis on maintaining this pace to assure the continued vitality and growth of the Japanese economy in the future.

This situation presents a difficult challenge to U.S. policymakers committed to enhancing defense technology cooperation with Japan. The United States has concluded that its chances for continued global influence rest in large part on the health of its technological base and is looking in part to Japan to enhance that technology base through cooperative programs. Others indeed equate allied cooperation and technology exchanges with the ability to assure mutual survival. One must ask if Japan — with its emphasis on retaining technology to assure its own survival — shares that assumption. If Japanese definitions of security involve broader economic concepts, then it would follow that it would not necessarily be in Japan's best interests to share technologies which it views as the key to its own economic success and, therefore, long term survival.

In this regard, understanding the Japanese process of technology management is only one step toward learning and benefitting from our Pacific ally. It is also essential to have access to the process since so much of it takes place within tightly established domestic networks. The challenge to future policymakers will be to achieve that goal by convincing Japanese decisionmakers of the desirability cooperation in the name of mutual security in its broadest sense, while retaining the positive aspects of head-to-head economic and technological competition.

[21] *Science and Technology in Japan*, Vol. 7, No. 26, June 1988.

Appendix: TRDI Research Facilities

First Research Center
- First division: Explosives; ammunition; small arms; artillery
- Second division: Armor; anti-ballistic structures
- Third division: Camouflage; parachutes.
- Fourth division: Hydrodynamics; battleship technology (structures; noise reduction).

Second Research Center
- First division: Communications; computer applications; information systems integration
- Second division: Radar; electronic warfare; microwave antennas/components
- Third division: Electro-optical systems; infrared systems

Third Research Center
- First division: FSX aerodynamics, stability/control, structure and system integration; helicopters; missiles, RVPs
- Second division: air breathing/rocket propulsion systems
- Third division: Missile guidance; fire control systems; sensors; navigation systems

Fourth Research Center
- First division: Mine warfare; protective structures
- Second division: Transmissions, suspension systems, engines and other vehicle subsystems
- Test division: Vehicle testing (tanks)

Fifth Research Center
- First division: Sonar; underwater acoustics
- Second division: Torpedoes; mines
- Field test/ evaluation division: Torpedo, mine testing
- Kawasaki branch: Shipboard degausing; magnetic sensors

Source: Boeicho, Jieitai (Boei Kenkyukai, 1988); pp. 289-293.